

THE
ARTIFICERS
PLAIN SCALE:

OR

The Carpenters new Rule.

In two Parts.

The first shewing how to measure all
Superficies and Solids, as Timber, Stone,
Board, Glasse, &c. Geometrically, with-
out the help of *Arithmetick* it being a
new way not heretofore practised.

The second shewing how to measure
Board and Timber Instrumentally, upon
the Scale it selfe, without *Arithmetick* or
Geometry, but what is common to
every man.

ALSO

How to take Heights and Distances several ways,
and to draw the Plot of a Town or City,

*Whereunto is added an Appendix containing the de-
scription of the line of Numbers, and the use
thereof in measuring of Board, and
Timber &c.*

By *Thomas Stirrup*. Philomat,

London, Printed by R. & W. Leybourn, for Thomas
Pierepont, at the Sun in Pauls Church
yard 1657.

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THE ARTIFICERS

PLAIN SCALING

A BOOK OF ARTIFICERS WORK

IN TWO PARTS.

The first showing how to measure all
structures and solids of Timber, Stone,
Brick, Galls, &c. &c. &c. &c. &c. &c. &c.
The second showing how to measure
all the work of the artificers.

The third showing how to measure
all the work of the artificers.



The fourth showing how to measure
all the work of the artificers.

The fifth showing how to measure
all the work of the artificers.

The sixth showing how to measure
all the work of the artificers.

The seventh showing how to measure
all the work of the artificers.

TO THE
READER.

Gentle Reader.

Although many
excellent both
in *Arithmetick*
and *Geometry*, upon infal-
lrble grounds have put
forth divers most certain
and sufficient rules for the
measuring of *Board* and
Timber, yet very few of
our common *Artificers*
have been furthered there-
by, because they have not

To the Reader.

the art of *Arithmetick*,
upon which most of their
rules depend.

The consideration of
which, with the aptnesse
which I see in some of
them for the raising of a
Perpendicular, & the draw-
ing of a *Parallel Line*, up-
on which most of this
Book depends: this, I say,
hath been the cause which
hath moved me to give
them some rules *Geome-
trical*, whereby they may
measure both *Board* and
timber

To the Reader.

timber, without the help
of *Arithmetick*.

Therefore to thy view,
Gentle Reader, that want-
eth the art of *Arithmetick*,
doe I prefer this short and
plain *Treatise*, wherein,
and in the beginning, is
declared the infallible
grounds upon which the
whole *work* doth depend,
and then doth follow the
applying of those rules to
the present purpose, with
the declaration of three
tables one for *Board* and
one

To the Reader.

one for *square Timber*, and the third for *round Timber*, very fit for all such as stand in need thereof, and yet want both *instruments* and *Aritbmetick*, whereby to use the same.

In the second Part of this Book is shewed a second way whereby you may measure Board and Timber by Rule and Compass only, without drawing of lines: and also how to take Heights and Distances several ways without Instrument, all which are grounded

To the Reader.

*grounded upon infallible
principles Geometrical.*

*To this second Edition
there is added an Appen-
dix which sheweth the de-
scription of the Line of
Numbers, and the use
thereof applyed to the mea-
suring of Board & timber.*

*Thus desiring thee to
accept of this little Booke
as a taste of my good will
towards thee which I
wish even so to further
thee, as I know it suffici-
ent for the true measuring
both of Board & Timber.*

FAREWELL.

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An Advertisement

To the READER.

FOrasmuch as throughout this whole Book, there is mention made of *Rules* and *Scales*, the making whereof is different from those which are vulgarly made and sold: if any therefore be desirous to have any particular Rule mentioned in this Book, or one Rule to performe all the work in general, he may have them exactly made by Master *Anthony Thompson* in *Hosier lane*, neer *Smithfield*, where also are made all other Mathematical *Instruments* whatsoever.



THE ARTIFICERS

Plain Scale,



CHAP. I.

*The meaning of certain
terms of Geometry u-
sed in this Book.*

BEcause all Carpenters
or other Artificers, in
their Trade or calling,
doe in a manner (and
according to their fa-
shion) use some kind of
Geometry, although themselves be
B ig:

ignorant thereof, therefore I did consider that they might be sooner brought to measure Board and Timber by that art of Geometry (seeing they have their Rule and Compasses by them) then by Arithmetick, being but few of them can write, and therefore incapable of that art: and of them few which can write, not one in ten that hath Arithmetick, which is the only cause (as I suppose) that most of them are so ignorant in this art (which doth so much concern them) notwithstanding, all those excellent Rules which have been formerly delivered by the Learned: But now to our intended purpose.

Seeing I shall have occasion in this Work to use some terms of Geometry, by which I may with more ease deliver, and you with more plainnesse perceive my minde in these things: I have therefore set down the meaning, [as plainly as I can, of some
Geo-

Geometrical terms, which most serve for our present purpose.

1 An *Angle* is nothing else but a corner, made by the meeting of two lines (for I speak not of solid angles.)

2 A *right Angle* (which we call a square angle) is that whose two lines comprehending or making the angle stand perpendicular or plumb the one to the other.

3 A *Perpendicular line* is that which stands plumb upright upon another, leaning neither the one way nor the other.

4 A *Superficies* is that which hath only Length and Breadth, and no Thickness at all.

5 A *Solid*, or a *Body* is that which hath Length, Breadth, and Thickness.

6 *Parallels* are those lines that differ every where alike, or are not nearer together in one place then another.

7 A *Figure* is any kinde of Superficies or Solid that is bounded about, as *Triangles, Squares, Circles, Globes,*

Cones, Prisms, and the rest.

8 The *Base* of a Figure is any side thereof upon which it may be supposed to stand; or if you take any side of a Figure for the Ground or Bottom, or lower part thereof, that same is the *Base*.

9 The height of a Figure is the length of a Perpendicular or plumb line, falling from the top thereof.



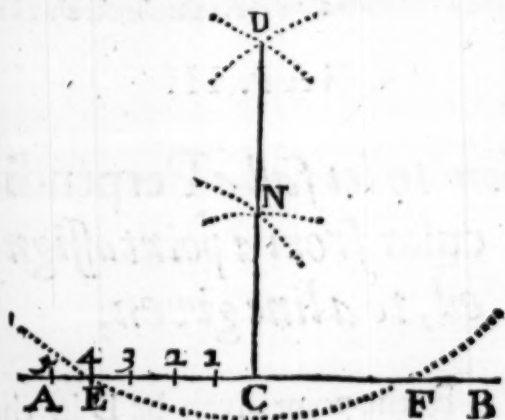
CHAP. II.

How to raise a Perpendicular on any part of a right line given.

L Et A B be a right line given, and let C be a point therein, whereon I would raise a perpendicular, open the Compasses to any con-

(5)

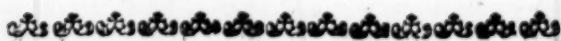
convenient distance, and setting one foot in the point C, with the other mark on either side thereof, the equal distances C E and C F: then opening your Compasses to any convenient wider distance, with one foot in the points E and F, strike two arch lines, crossing each other as in D, from whence draw the line D C, which is a perpendicular to A B, or as we call it, a square line to the line A B,



Or you may from the given point C, prick out any five equal distances, and opening your Compasses to 4 of
B 3 them,

(6)

them with one foot in C, strike an arch or piece of a Circle towards N, then opening your Compasses to all five divisions. with one foot in 3, cross the same arch line in N, from whence draw the line NC, which is a perpendicular to the line AC, as before, for if three lines be joyned together, so they be in such proportion, as 3, 4, and 5; they will make a right angle.



CHAP. III.

How to let fall a Perpendicular from a point assigned, to a line given.

LEt the point given be D in the former Chapter, and let the line whereon it should fall be AB, open the Compasses to any convenient

(7)

venient distance, and setting one foot in the point D, make an arch or piece of a Circle with the other foot, till it cut the line A B twice, that is at E and F, then find the middle between those two Intersections, and from that middle, draw a line to the point D (which is the point given) & that line shall be perpendicular or plumb from the point D to the line A B, as was required.



CHAP. IV.

To a line given, to draw a parallel line, at any distance required.

Suppose the line given to be A B, unto which I must draw a parallel.

Open your Compasses to the distance

(8)

stance required, and setting one foot of your Compasses in the end A, strike an arch on that side the given line whereon the parallel is to be drawn, as the arch C, then do the like in the end B, as the arch line D, then draw the line C D, so as it may but touch or be a touch line to these two arches C and D, and this line so drawn shall be parallel to the line A B, as was required.

CHAP.



CHAP. V.

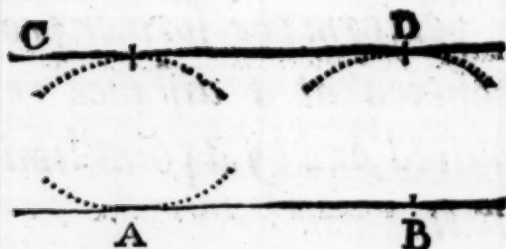
To perform the former proposition at a distance required, and by a point limited.

ADmit AB in the former Chapter, to be a right line given, whereunto it is required to have a parallel line drawn at the distance, and by the point C.

Place therefore one foot of your Compasses in C, from whence take the shortest distance to the line AB, as CA, at which distance, with one foot in the end B, with the other strike the arch line D, by the extreame part of which arch line D, and the point C, draw the line CD, which
is

(10)

is parallel to the given line AB, which was required.



CHAP. VI.

*Having two lines given, to
finde a third proportional
line to them*

THe two lines given are A and B, and it is required to finde a third line which shall be in such proportion to A, as A is to B, Make any angle wharsoever, as the angle H E C. Here

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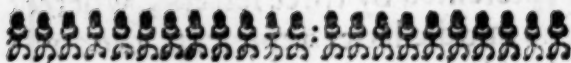
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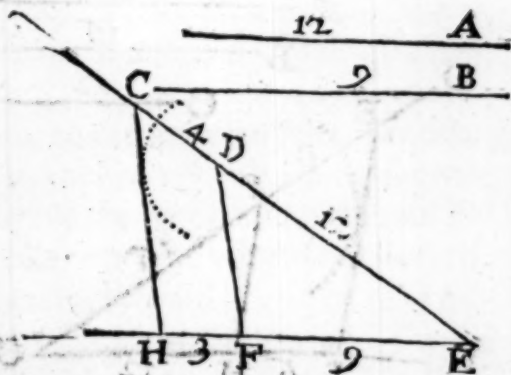
CHAP. VII.

Having three lines given to find a fourth proportional line to them.

THe three lines given are A B and C, and let it be required to finde a fourth line, which shall have such proportion to A, as B hath to C, make any angle, as D G K, now seeing the line C hath the same proportion to the line B, as the line A to the line sought for, therefore place the line C from G to H, and the line B from G to F, then draw the line F H, now place the line A from G to I, by which point I draw the line E I parallel to F H, till it cutteth D G in E, so have you

(13)

you E G the fourth proportional line
required, which is 24.

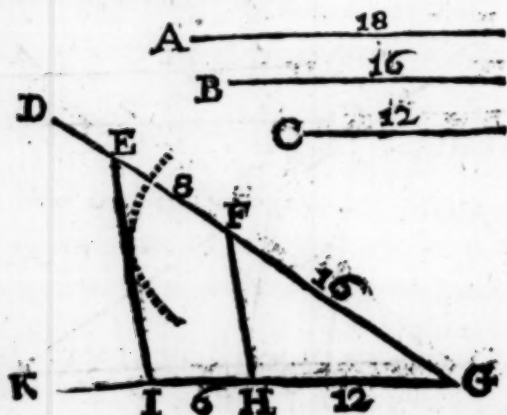


For as the line 12, is to the line 16,
so is the 16, to the line 24, which
is the length of the line we sought
for.

These two last Chapters, would
I have you diligently to consider, and
thoroughly to learne, because it is
the ground-work of that which I
intend to deliver in this Booke:
which being well understood, will
bring much pleasure and profit to the
un-

(14)

unlearned Artificer, for whose sake
this was written.



CHAP. VIII.

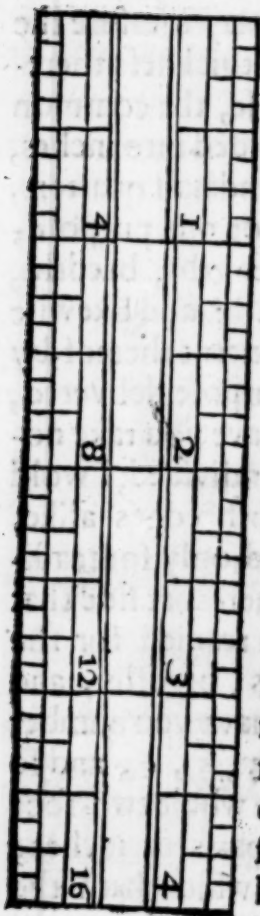
*The making of a Rule or
Scale, for the measuring
of Board and Timber.*

BEfore we can give the true con-
tent of any Board or piece of
timber, we must have some Rule
or

or Scale whereby we may measure the length, breadth, and thickness thereof, and for this purpose, the common Rules, commonly divided into inches, half inches, quarters, and half quarters, will very well serve for our purpose; both for to measure lengths, breadths, and thicknesses withall: and likewise for to give the true content thereof, by the Rules to that purpose delivered, only herein, I would have you take notice, that this scale thus divided, I would have drawn upon both edges alike, but differently figured, only for readinesse, after this manner, that side that you would have the readiest for the measuring of lengths, breadths, and thicknesses, I would have you number them with 1, 2, 3, 4, 5, 6, and so unto 24, dividing the whole two-foot Rule, into 24 equal parts or inches; and the other edge, which hath the same divisions, I would have you number with 4, 8, 12, 16, 20, 24, unto 96: dividing the whole two foot

in

(16)

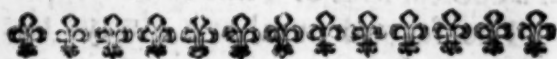


into 69 equal parts ;
that is, every inch in-
to 4 parts, only for
readiness sake in the
work which doth fol-
low.

This line thus di-
vided , is called a
Scale ; which is no
other thing into any
number of equal
parts, be they greater
or lesser , wider or
narrower, so they be
equal : every part, or
division of which
line may stand for a
mile, a rod , a yard, a
foot, an inch, or any
other kinde of mea-
sure what you will, or
have use of: and this
line I would have

you use, in giving up the Content of
either Board, or Timber.

I have described this Scale but to 4 inches ; but you may thereby perceive what I mean by the whole Rule.



CHAP. IX.

How any Board may be measured Geometrically.

IF you do well understand that which hath been delivered in the seventh Chapter, you may thereby measure any Board with ease and delight ; for as there is three numbers, or three lines given , whereby the fourth proportional is found : so in every Board there is three lines , or numbers (which you will) which be given us , whereby, we may by the seventh Chapter finde a fourth proportional line or number : which is the number of feet contained in the whole board.

C

The

The first of the three Numbers given, is always 12, which is the side of a square foot of Board, or the side of a cubical foot of Timber ;

The second number is always the number of feet, contained in the length of the Board; The third number is always the number of inches contained in the breadth of the Board.

And the fourth number which is here sought for, will always be the number of square feet, contained in the whole Board : the proportion will be always thus,

As 12 to the length in feet ;
 So the breadth in inches,
 To the Content in Feet.

And seeing examples teach better than many words : therefore let us suppose the three lines given us in the seventh Chapter, to be three such numbers as here we have spoken of.

And therefore let the first line C,
 be

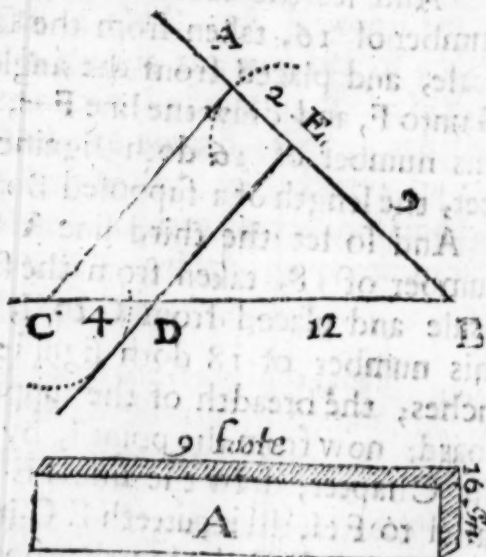
be a number of 12, taken from some scale with your Compasses, and placed from G to H, which 12 doth signifie 12 inches; which is the side of a square foot of Board.

And let the second line B, be a number of 16, taken from the same Scale, and placed from the angle at G unto F, and draw the line F H, and this number of 16 doth signifie 16 feet, the length of a supposed Board.

And so let the third line A be a number of 18, taken from the same Scale and placed from G to I; and this number of 18 doth signifie 18 inches; the breadth of the supposed board: now from the point I, by the fifth Chapter, draw the line I E parallel to F H, till it cutteth E G in E: So have you E G the fourth proportional line required; which being taken between your Compasses, and applied to your Scale, will shew it to be 24, and so many square feet are in that Board, whose length is 16 foot;

and breadth is 18 inches.

Let us take one Example more, for plainnesse sake, let the figure A, be a board to be measured, whose length is 9 foot, and breadth 16 inches: now



draw 2 lines, so as they make any angle, as the angle A B C, which being done, first, take 12 from your Scale, and place it from B to D, then take 9 of the same divisions, which doth signifie 9 foot, the length of the board and

and place them from B to E, and draw the line E D, then take 16 of the same divisions, (which doth signifie 16 inches, which is the breadth of the Board,) and place them from B to C: and lastly, by the fifth Chapter, draw the line C A, parallel to D E, till it cutteth A B in A, so shall A B be the fourth proportional number; which being applyed unto your Scale, will reach unto 12; and so many square feet are in that Board.

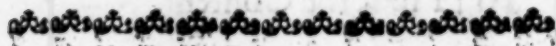
For, as 12 is to 9 foot, the length:
 So is 16 the breadth,
 To 12 foot the Content.

And here note, that when you have any odde parts of an inch in the breadth of your board you must take the like parts of one division from your Scale, more then your even parts was: and so must you doe when you have odd parts of a foot in the length of your Board: as for example, suppose a board to be eight foot, and
 three

three quarters long; now for to set down this length you must take from your Scale eight whole divisions, and three quarters of one; and so apply them to your use; and this must be noted throughout this Book.

And here note also, that if your board be taper-grown, that is, wider at one end then at the other; then measure the breadth thereof in the middle, and with that wideness proceed according to your Rules given.

And this may very well suffice for Timber that doth taper also.



CHAP. X.

How Timber may be measured geometrically.

THe measuring of timber doth little differ from measuring of Board, by the last Chapter, but only in measuring of Timber
we

we have a double work, but the last Chapter well understood, will give light sufficient hereunto.

Therefore by the last Chapter first, measure how many square feet of flat measure there is in one of the sides of your Timber, as if it was a board by it self, which being done, you have three numbers given you, whereby you may by the seventh Chapter finde a fourth in proportion unto them, which fourth number, is the number of Cubical feet contained in that piece of Timber

The First number is always 12.

The Second is always the number of square feet contained in one of the sides, I mean, of flat measure.

The third, is always the number of inches contained in the thickeffe of the Timber: and this will be always the proportion for this work.

First, As 12 is to the length in feet,
so is the breadth in inches,

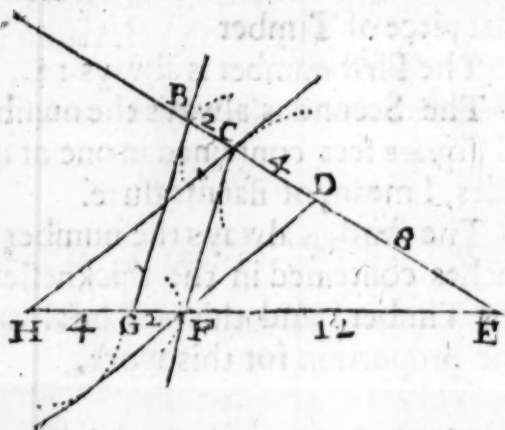
To

(24)

To the superficial content, of that
same side.

Secondly, As 12 to this superficial
content,

So is the thicknesse in inches,
to the solid content in feet,



As for example, suppose the figure
A

A to be a piece of Timber to be measured, whose length is 8 foot, and breadth 18 inches, and thicknesse 14 inches.

Now draw two lines, so as they may make any angle as the lines B E, and H E, meeting in the angle E, this being done, first, place 12 (which is the side of a Cubical foot: of Timber) from E to F, then place 8 (the length of your piece in feet) from E to D, and draw the line D F, and then place 18 (the breadth of your piece in inches) from E to H, and then by the 5 Chapter, draw the line H C, parallel to D F, till it cutteth B E, in C: So shall C E be the number of feet of flat measure, contained in the broadest side of the piece of Timber

Thus far we have proceeded according to the last Chapter; and now we have three numbers more given us, whereby we may finde a fourth proportional unto them.

Wherefore, first, we have 12 already

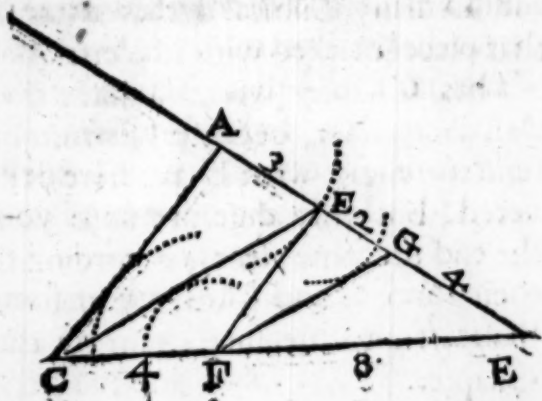
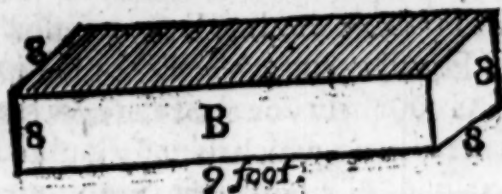
dy placed, from E to F, Secondly, we have the superficial content of the broadest side, already placed from E to C: therefore draw the line F C, and thirdly, we have 14 the number of inches contained in the thickeſſe, which we muſt place from E to G: and laſtly, from the point G, by the fiſt Chapter draw the line G B parallel to F C, till it cutteth B E at B: So ſhall B E be the number of Cubical feet contained in that piece of Timber noted with the Letter A, which being taken between your Compaſſes, and applyed unto your Scale, will reach unto 14, and ſo many feet is in that piece.

Now here I will give you one example, of a piece of Timber hewed juſt ſquare: Let the figure B be a piece of Timber ſo hewed, whoſe length is 9 foot. And let it be 8 inches ſquare, now having made any angle, as the angle A D C, firſt place 12 from D to C.

And

(27)

And 9 foot the length, from D to A, and draw the line C A, then place 8, the thickeſſe of one of the ſides, from D to F, and by the 5 Chapter, draw the line F E parallel to C A, till it cutteth D A, at E, ſo ſhall E D, be the ſuperficial content, of one of the ſides, thus far according to the ninth Chapter, as if it had been a board.



And

And now here we have three numbers, already placed, whereby we may finde a fourth, after this manner. First, we have 12 here placed from D to C, and we have the superficial content of one of the sides, placed from D to E, and therefore draw the line C E, and here we have also, 8 the thickness of one of the sides, already placed from D to F, from which point F, draw the line F G, parallel to C E, till it cutteth A D, in G, so shall G D, shew you the solid content of that piece, which being applyed unto your Scale, will reach unto four, and so many Cubical feet is there in that piece, marked with the letter B.

This Chapter would I have you well to consider, because I do not intend to repeat, what I have here delivered, but only describe unto you, the end of some pieces, according to their formes, and so give you some Rules, for to measure them by this Chapter.

CHAP.

CHAP. XI

Of round Timber.

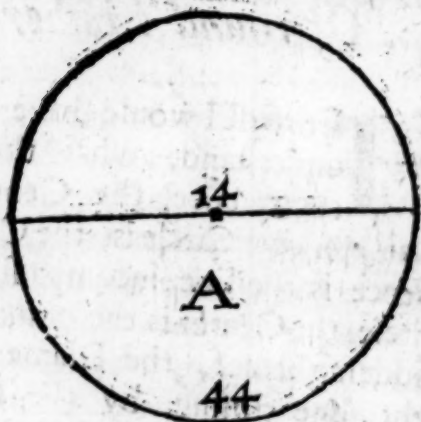
Here first I would have you to understand, what the Circumference, the Center and Diameter of a Circle is; the Circumference is the line incompassing the Circle, the Center is the point in the midst thereof, the Diameter is a right line passing by the Center through the whole circle, and divideth the same into two equal parts, either half of which Diameter is called the Semidiameter.

Now having found the circumference of a round piece of Timber, by girding it about with some line, I think it is here needful, to give you a Rule, for the finding of the Diameter of the same piece.

There-

(30)

Therefore consider that every Circumference, is in such proportion to his Diameter, as 22 is to 7, therefore having these two numbers given you,



and the circumference of your piece of Timber, you may by the 7 Chapter, finde a fourth proportional unto them, which will be the Diameters sought for. As for example, let the figure A be the end of a round piece of Timber, whose Circumference is found by girding it about, for to be 44 inches, now working by the rule
given

given, you shall finde the Diameter to be 14 inches.

For, as 22 is to 7.

So is 44 to 14.

Now the Circumference and Diameter being found, you may finde the solid content, after this manner, First, take one half of the circumference, for the breadth of your piece, and one halfe of the Diameter for the thickeffe, thereof, according to which breadth, and thickeffe, you may proceed in all things, (by the former part of the tenth Chapter) as if it were an unequal squared piece of Timber, as in the figure A, take 22 inches; (the Circumference of the piece) to the breadth thereof.

Or take a quarter of 44 that is 11 for the one side, and the whole 14 for the other.

And take 7, which is the halfe of 14 the Diameter, for the thickeffe thereof; and so with this breadth, and thickeffe

thicknesse, proceed in all things according to the former part of the tenth Chapter.

Of the half-round, or quarter, or any other portion or part of a Circle.

FOr this halfe Circle, take halfe the arch line CDB , which is 11, for the breadth of your piece.

And one halfe the Diameter, which is 7 for the thicknesse thereof and proceeding with this breadth and thicknesse, by the tenth Chapter, you shall finde the content.

And so for a quarter of a circle, or any other portion, (which goeth to the center) take one halfe of the arch, belonging to that part of the Circle, for the thicknesse of one of the sides, and take the Semidiameter, for the thicknesse of the other side. As in the quarter ACD , take one half the arch
line

line C D, which will be five and a halfe, for the thickeffe of one of the



sides, of that piece of Timber, and take the Diameter A C which is 7 for the other side of the same piece, with which two sides, as if it were an unequal squared piece, of Timber, cast up the content, by the former part of the tenth Chapter, performing all things, as before in that Chapter.

Now having a piece of a Timber, whose end shall be like unto this portion of a Circle, noted with these letters A B C D, before we can give the content thereof, it will be needful to finde out the Center, which for to doe work as followeth.

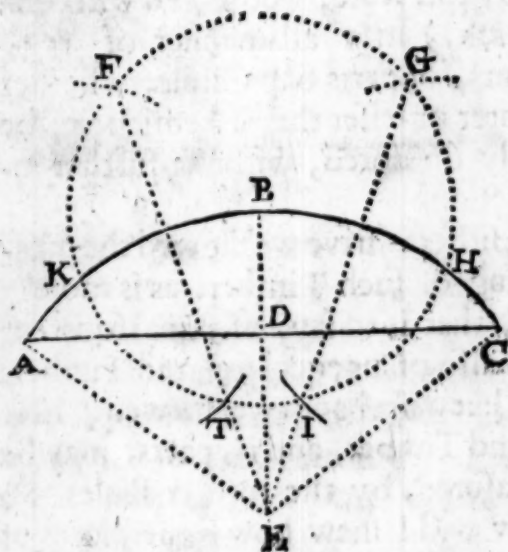
D

A

A Segment of a Circle being given, to finde out the Center, and consequently the Diameter, and so if need be, the whole Circle.

LET ABC , be part of a Circle given, to finde out the center thereof, first take a point at pleasure, with most convenience, in the arch ABC , as at B , now on the point B , at any meet distance, describe the Circle $FGHITK$, which being done, remove the Compasses to the point H , (where the Circle crosseth the arch line given,) now one foot being in the point H , and at the same distance, as before, crosse the Circle twice, as at G and I and with the same distance, on the point K crosse the said Circle twice more, as in I and F , and lastly, by these intersections or crossings, draw

draw the lines F E and G E, till they meet, or crosse the one the other, in the point E, which shall be the center required:



The center being found, draw the lines E A and E C, and cast up the whole figure A B C E, as before is shew'd, and then by the next Chapter, finde the content of the Triangle A C E, and take it from the content

of the whole figure $A B C E$, and that which is left, shall be the content, of the figure $A B C D$, as was required.

By this Rule, (observed with discretion,) may all manner of Segments, or parts of a Circle, whether greater or lesser then a Semicircle, be easily measured, without further instruction.

Hitherto have we shewed the measuring of such Timber, as is most in use, that is to say, of equal squared, and also of unequal squared Timber, so likewise have we shewed, how round Timber, and its parts, may be measured, by the former Rules. So now will I shew how some pieces of extraordinary forms, may be brought to be measured, by the former Rules.

CHAP.



CHAP. XII.

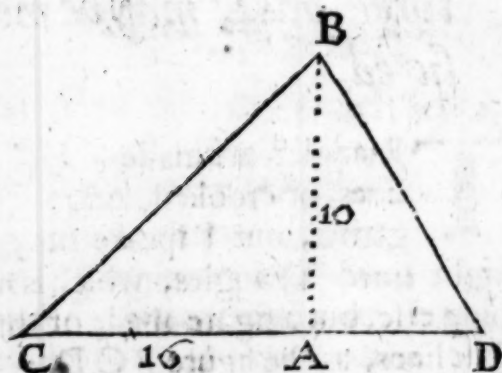
*How Triangled Timber, or
Timber which hath but
three sides, may be mea-
sured.*

Triangles, are made of straight lines, or crooked, or both together, but I speake only of Right lined Triangles, which is nothing else, but a figure made of three right lines, as the figure B C D.

Triangles are divers, both in respect of their sides and angles, and may be measured divers ways, but let this one way serve for all: take halfe of the base, and suppose it to be one side of a squared piece of Timber, and take the whole height, or perpendicular, for the other side of the same piece,

piece, and so measure it by the former part of the tenth Chapter, in all respects, as there is shewed

Let the Triangle $A B C$, be the end of a piece of Timber to be measured, which hath but only three sides.



Now seeing the Base BC is 16, I take one halfe thereof, which is eight inches, for one side of a piece of Timber, and take 10, the whole length of the perpendicular, (which is the pricked line AD for the other side of the same

same piece : and so as if it were a piece of 10 inches broad, and eight inches thick, you may cast up the contents by the former Rules.



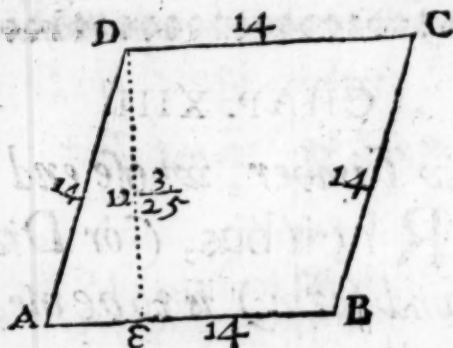
CHAP. XIII.

How Timber, whose end is a Rhombus, (or Diamond form) is to be measured.

A Rhombus (or diamond) is a figure of four equal sides, but no right Angles, such as is the figure A B C D, for the measuring whereof, observe this example. Let the said figure A B C D, be the end of a piece of Timber to be measured: now taking the length of the side or base A B, which is 14 inches for one of the sides of a squared piece of timber,

(40)

ber, and the length of the perpendicular D E, which will be found to be 12, and something better then the eight part of one more, for the other



side of the same piece, with which two sides, as if it were an unequal squared piece of timber, proceed in all things, according to the former part of the tenth Chapter.

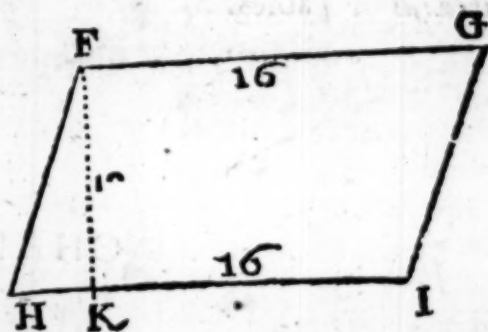
CHAP.



CHAP. XV.

How Timber whose end is a Rhomboides (or Diamond-like) is measured.

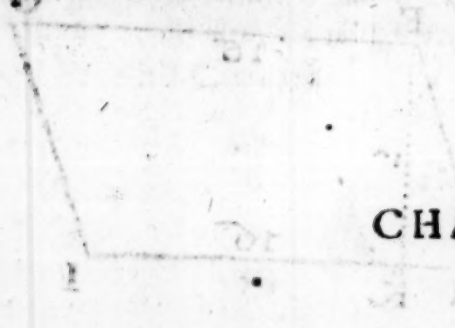
A *Rhomboides* (or Diamond-like) is a figure, whose opposite sides, and opposite Angles, are only equal, and it hath no right Angles. Such as is the figure F G H I,



and

and may be measured after this manner: take the length of the side HI , or FG , which is 16 inches for one side of a squared piece of timber, and take the perpendicular FL , which is 10 inches, for the other side of the same piece, and so you may measure it by the former part of the tenth Chapter, as if it were an unequal squared piece of 16 inches broad, and 10 inches thick.

All other four sided figures besides the true Square, and the unequal Square in the tenth Chapter, and the Rhombus in the last Chapter, and the Rhomboides in this, are called *Trapezias* or Tables.

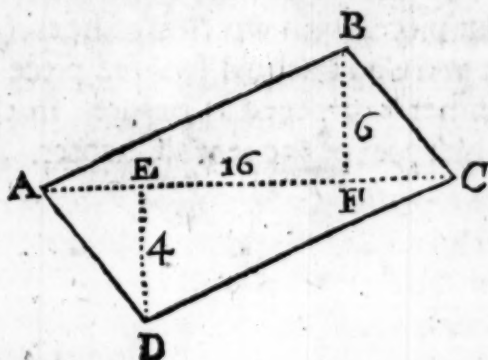


CHAP.

CHAP. XV.

*How to measure Timber,
whose end is a Trapezium.*

A *Trapezium* is any irregular four sided figure of what fashion soever, as the figure A B C D is a Trapezium, and may be cast into



two Triangles, by drawing the Diagonal

gonal line AC , and so each Triangle measured as is before shewed, which being done, adde the contents of them both together, and you shall have the content of the whole Trapezium $ABCD$. Or you may more readily measure it thus: Take one halfe of the Diagonal line AC , which in this example will be 8 inches, for one side of your piece, and take the two perpendiculars BF and DE , and joyn them both together in one sum, so shall you have in this example 10 inches for the other side of your piece, with which two sides, (as if it were an unequal squared piece of Timber) proceed as before, in the former part of the tenth Chapter.

CHAP. XVI.

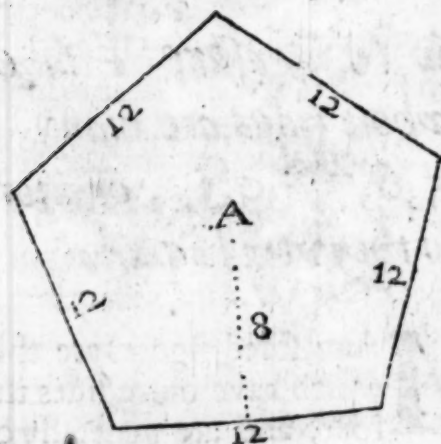
*How to measure Timber,
whose sides are many, as
5, 6, 7, 8, 9, 10, or more,
so they be all equal.*

MAny sided figures are those which have more sides than four, and are generally called *Polygons*.

A piece of Timber whose end shall have more sides than four, may be measured after this manner, add all their sides together, and take halfe that number for one side of an unequal squared piece of Timber, then let fall a perpendicular from the centre or midst of the figure, to the midst of some one side, and take that length for the other side of the same piece,

(46)

piece, with which two sides proceed
as before is shewed.



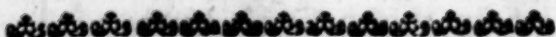
Suppose the figure A to be the end
of a piece of Timber of five sides, be-
ing all equal, and each side conteining
12 inches, which being added toge-
ther into one sum will make 60, the
half whereof will be 30 for the
breadth of your piece, then take the
length of the perpendicular (falling
from the center A to the midst of one
of

of the sides,) which here is 8 inches,
for the thicknesse of the same piece,
with which breadth and thicknesse
proceed in all things according to the
former part of the tenth Chapter.

This rule is general in all kinde of
regulrr *Polygons*, how many sides
soever they have.

*Here I might have proceeded to have
shewed by what means Pyramidal or
picked Timber, or Steeples may be mea-
sured: but considering how little this ap-
pertaineth to Carpenters, and how suf-
ficiently they be handled by Master
Diggs in his Geometrical works, I for-
bear here to write of them.*

CHAP.



CHAP. XVII.

*How to finde the length of
a Foot of Board, at any
breadth given.*

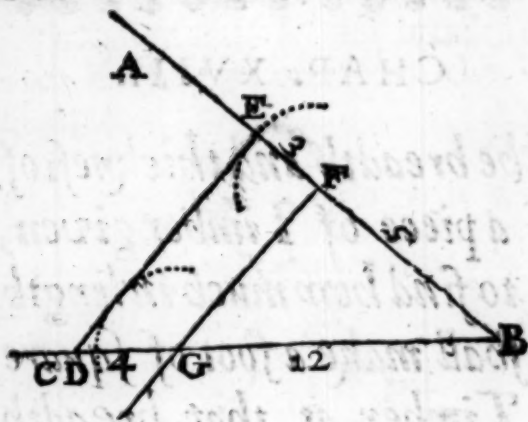
THe breadth of a Board being given, with the number of 12, (the side of a square foot of Board,) you may by the sixt Chapter finde how much in length will make a foot at any given breadth, by finding a third proportional number, which shall be to 12, as 12 is to the given breadth.

As suppose a Board to be 16 inches broad, and I would know how much in length will make a foot thereof.

First, make any angle, as ABC , then place 16 inches, the breadth of your Board, from B to D , and 12 inches

(49)

inches from B to E, and draw the line
D E.



Then againe place 12 from B to G,
from which point G (by the fifth
Chapter) draw the line GF parallel
to D E, till it cutteth A B in F, so
shall F B be the length of a foot of
Board at 16 inches broad, which be-
ing applyed to your Scale, will reach
unto 9, which doth shew, that at 16
inches breadth, 9 inches in length
doth make a foot of square Board:

For, As 16 is to 12;
So is 12 to 9.

E

CHAP.



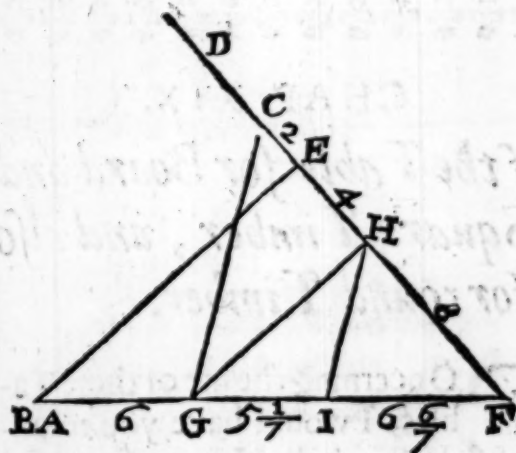
CHAP. XVIII.

*The breadth and thickness of
a piece of Timber given,
to find how much in length
shall make a foot of square
Timber at that breadth
and thickness.*

Suppose a piece of Timber to be 18 inches broad, and 14 inches thick. First, make any angle, as DFB , and place 18 inches from F to A , this is the supposed breadth of your piece; then place 12, the side of a Cubical foot of Timber from F to E , and draw the line AE : So likewise place 12 from F to G , from which point G , draw the line GH parallel to

to

to A E, till it cutteth FD in H, so shall H F be the length of a square foot of flat measure at the former breadth given: thus far according to the last Chapter.



Now to proceed, place 14 the thicknesse of your piece from F to C, and draw the line C G, and lastly, from the point H, draw the line H I parallel to C G, till it cutteth F B in I, so shall I F be the length of a foot required, which being applyed to your Scale,

wanteth but one seventh part of an inch, and such is the length of a foot of Timber whose breadth is 18 inches, and thicknesse 14 inches.



CHAP. XIX.

Of the Table for Board and Square Timber, and also for round Timber.

COncerning the use of these Tables, I would have you to understand that I have supposed the inch to be divided into 10 equal parts, and each part divided into 10 equal parts, and so the whole inch will contain 100 equal parts.

A Table for Board measure

Inches.	Feet	Inche s.	10 part of In.	10 part of a 10 part.	Inches.	Inches.	10 part of In.	10 part of a 10 part.
1	12	00	0	0	16	9	0	0
2	06	00	0	0	17	8	4	7
3	04	00	0	0	18	8	0	0
4	03	00	0	0	19	7	5	7
5	02	04	8	0	20	7	2	0
6	02	00	0	0	21	6	8	5
7	01	08	5	7	22	6	5	4
8	01	06	0	0	23	6	2	6
9	01	04	0	0	24	6	0	0
10	01	02	4	0	25	5	7	6
11	01	01	0	9	26	5	5	3
12	01	00	0	0	27	5	3	3
13		11	0	7	28	5	1	4
14		10	2	8	29	4	9	6
15		09	6	0	30	4	8	0

A Table of Square Timber measure.

Inches.	Feet	Inches.	10 part of In.	10 part of a 10 part.	Inches.	Inches.	10 part of In.	10 part of a 10 part.
1	144	00	0	0	16	6	7	5
2	36	00	0	0	17	5	9	7
3	16	00	0	0	18	5	3	3
4	9	00	0	0	19	4	7	8
5	5	09	1	2	20	4	3	2
6	4	00	0	0	21	3	9	1
7	2	11	2	6	22	3	5	7
8	2	03	0	0	23	3	2	6
9	1	09	3	3	24	3	0	0
10	1	05	2	8	25	2	7	6
11	1	02	2	8	26	2	5	5
12	1	00	0	0	27	2	3	7
13		10	2	2	28	2	2	0
14		08	8	1	29	2	0	5
15		07	6	8	30	1	9	2

A Table of round Timber measure.

Inches,	Feet.	Inches.	10 part of In	10 part of a 10 part.	Inches.	Inches.	10 part of In	10 part of a 10 part.
1	113	01	7	1	16	5	3	0
2	28	03	4	2	17	4	6	9
3	12	06	8	5	18	4	1	9
4	7	00	8	5	19	3	7	6
5	4	06	3	0	20	3	3	9
6	3	01	7	1	21	3	1	1
7	2	03	7	0	22	2	8	0
8	1	09	2	3	23	2	5	6
9	1	04	7	6	24	2	3	5
10	1	01	5	7	25	2	1	7
11		11	2	2	26	2	0	0
12		09	4	2	27	1	8	6
13		08	0	3	28	1	7	3
14		06	9	2	29	1	6	1
15		06	0	3	30	1	5	1

The

The first column towards the left hand, doth contain any number of inches, from one to 30.

In each of these Tables, is set down the length of a foot in feet and inches, and the tenth part of an inch, and so to the tenth part of one tenth part of an inch, that is to the hundredth part of an inch.

Of Board Measure.

An example upon each Table, will give more light than many words, and therefore, first, of Board: suppose a Board to be 7 inches broad: then find 7 in the first column towards the left hand, and over against it, under the title of Board Measure, you shall find one foot, 8 inches, 5 tenths of an inch, and 7 tenths of one tenth part of an inch, and such is the length of a foot of Board at that breadth.

And so if a Board be 14 inches, broad, look 14 in the column towards
the

the left hand, and against it under the title of Board Measure, you shall find 10 inches, two tenths of an inch, and eight parts of one tenth part of an inch; for the length of a foot at that breadth, and the like is to be observed for Timber.

Of Square Timber.

Suppose a piece of Timber to be 10 inches square, look 10 to the left hand, and over against it, under the title of square Timber, you shall find one foot, five inches, two tenths of an inch, and eight parts of one tenth, for the length of a foot.

If the square given be 16 inches, then over against 16, under the title of square Timber you shall find 6 inches, 7 tenths of an inch, and 5 parts of one tenth.

Of Round Timber.

• For Round Timber, gird the piece
about

about with some line, and with a quarter thereof enter your Table, and over against it under the title of Round Timber, you shall finde the length of a foot.

As suppose a stick to be 44 inches about, the quarter whereof is eleven inches, with which I enter the Table, in the column towards the left hand, and over against it, under the title of Round Timber, you shall finde a 11 inches, two tenths of an inch, and two parts of one tenth part of an inch, which is the length of a foot, at that thicknesse, and if that piece had beene but 28 inches about, then the quarter thereof would have been but 7 inches, which being found to the left hand of the Table, over against it under the title of Round Timber, you shall finde two feet three inches, and seven tenth parts of an inch, which is the length of a foot at that thicknesse.

Note.

And hereby will appear, that gross
error

ertour which Carpenters use in taking a quarter of the Circumference, for the true square of that piece, which indeed it is not: for here against 7, in Timber which is square, there standeth two foot, 11 inches, two tenths of an inch, and six parts of one tenth, whereby it doth plainly appear, that at this thicknesse they do make their foot too long by 7 inches, 5 tenths, and 6 parts of one tenth part of an inch. These three Tables may be placed upon your Rule, according to the ordinary manner.



CHAP. XX.

How to finde a mean proportional line between two lines given.

THe Tables of Timber measure serves for such Timber as is just square or round, it will not be unnecessary

unnecessary to shew you how to finde a mean proportional line, between two lines given, or to bring an unequal squared piece of Timber, to a true square, and so to apply it to your table.

Let a piece of Timber to be measured, be 9 inches broad, and 4 inches thick. Now : because it is not just square, it cannot be measured by the Table, therefore we must finde a mean between the two given sides, after this manner.

First, take 9 from your Scale, and place it on the line A C from C to D, and place four of the same divisions, from D to A, upon which line A C describe the Semicircle A B C, and



on

on the point D (where the two lines are joynd) by the second Chapter, raise a perpendicular to cut the circumference in B, so shall B D be the mean proportional line desired, which being applyed to your Scale, wil reach unto 6.

So that it doth appear, that a piece of Timber that is 9 inches broad, and 4 inches thick, is equal to a piece of 6 inches square.

And hereby doth another of our Carpenters errors appear, which is this, they do put both sides together, and then they take half of that number, for the true square of that piece, which is meerly false. For in this example, joyn 9 and 4 together, and they will make 13, the half whereof is 6 and a halfe, which indeed, according to our Rule should be but six.

Having found the mean proportional number, you may enter the Table of Timber therewith, as hath been formerly shewed, concerning square
Timber.

Timber. By this Rule the ingenious Practitioner may bring any of the former pieces, of what fashion soever, to be measured by the Table of Square Timber

And hee that hath Arithmetick, may apply the proportions given in this Book, to the *Rule of Three*, and thereby he shall finde the contents as before.



The end of the first Part.





THE
ARTIFICERS
Plain Scale.

The second Part.

CHAP. I.

Of the Scale, and the graduations or divisions thereof, and how they are to be used.

THe Scale here mentioned in this second Part, is a two foot Rule made with a joynt, having a line of equal parts issuing from the center thereof, and divided
into

into 100 equal parts, upon the flat or edge thereof, may be made the other Rule according to the directions and figures in the preceeding Part, so that any Artificer having his Rule and a pair of Compasses about him, may measure his Board, timber, or stone, two several ways.

And before I come to any particular Propositions of the measuring of any timber, or Board, I will first shew the use of this opening Scale, in finding of proportional Lines, which is the ground of the way of measuring in the former Book, and also apply the use of them to some other Conclusions following.

CHAP.



CHAP. II.

To divide a line given, into any number of equal parts.

THe line given is A B, and it is required to divide the same into five equal parts.

Take with your Compasses the given line A B, and fit that in any number that may be equally parted into five without any remainder, as fit it in 100, there let the Scale rest, then take it over in one fifth part thereof, viz. in 20, and that distance set from A to 1, so is A 1 one fifth part of the given line A B, which was required.

F CHAP.



A



CHAP. III.

 $\frac{3}{8}$

To take any part or parts of a line.

C

THe line given is A B, now of the same line it is required to cut off three eight parts thereof.

 $\frac{5}{8}$

Take the given line AB, and apply it to some number that may be parted in 8, which 8 is the Denominator, and take it over in the Numerator, or fit it in so many times the Denominator as you please, and take it over so many times the Numerator.

B

As fit A B in 80, which is 10 times 8 the Denominator, there let rest the Scale, then take it over in

in ten times the Numerator, viz. in 30, and that distance set from A to C, so is A C three eight parts of A B given: then must C B be the rest, which is five eights. For if you take it over in 50, which is 5 eights of 80, (as the Scale stood wherein the line A B was fitted) and C B will appear to be the rest.

CHAP. IV.

*A line conteining any part
or parts of a line, hereby
to finde the whole line.*

Suppose that A B be three eight parts of some line, and let it be required to finde the whole line.

Take both Numerator and Denominator so many times as you please, as take each ten times, makes 30 and

50, then take the line **AB**
 and fit that in 30, and
 there let rest the Scale,
 then take it over in 50, &
 that distance lay down for
 the line **CD**, and so shall
CD be the whole line,
 whereof **AB** was three
 eights.



CHAP.

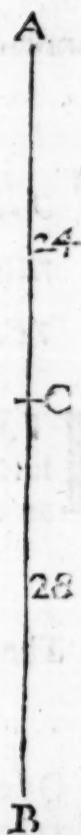
CHAP. V.

*A line being given,
containing any
number of equal
parts, to cut off
from it so many as
shall be required.*

AS let AB be a line
given, containing 52
parts upon some
Scale, and let it be required
to cut off from it 24 of the
same parts.

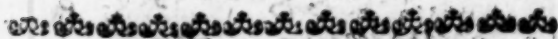
Take with your Com-
passes the given line AB,
and set that in 52 of the e-
qual parts, there let rest the
Scale, then take it over in

F 3



24

24, the parts required, and that distance let from A to C, so is A C 24 of the same parts, whereof A B is 52, which was required to be done.



CHAP. VI.

To lay down sodainly 2, 3, or more lines in proportion required.

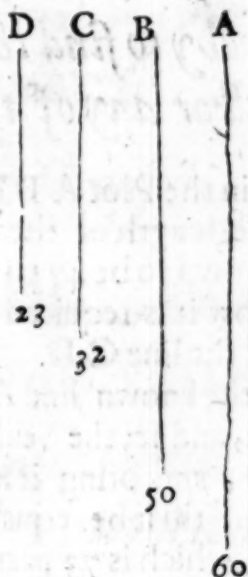
IT is required to lay down foure lines in proportion one to another, as these four numbers following.

	60	A	
The numbers given	{	50	B
		32	C
		23	D

Open by chance your Scale, and
 there let it rest, then take it over in 60
 and

(71)

and in 50, and lay them both down,
also take it over in 32 and 23, and lay
them down, and so have you four
lines A, B, C, D, in proportion, ac-
cording to the four numbers given.



CHAP.



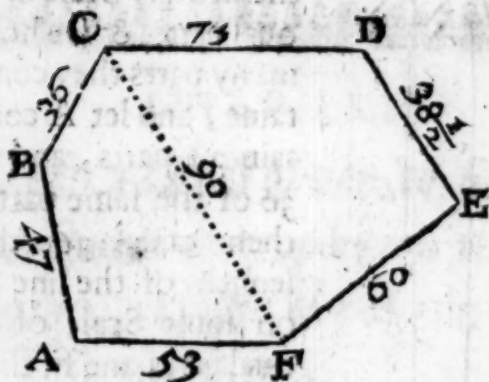
CHAP. VII.

*In a Map or Plot, the length
of any line being known,
thereby to find the length
of all or any of the rest.*

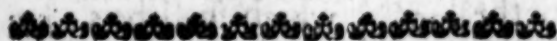
AS in the Plot A B E D E F, let the length of the line A B be known to be 47 parts, on some Scale, now it is required to finde the length of the line C D.

Take the known line A B, and fit that in 47, and let the Scale rest, then take C D, and bring it along the equal parts, till it be equally fitted on each side, which is 73 parts, so is C D 73 of the same as A B is 47, the like of all the rest.

But if you desire the distance from C to F, take it, and bring it along
your



your Scale as it standeth, so finde
you 90.



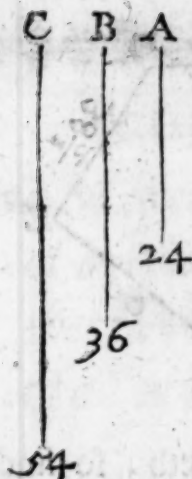
CHAP. VIII.

*Unto twolines givento find
a third in proportion.*

THe two lines given are A and
B, and it is required to finde a
third in proportion.

Take the two lines given, and apply
them

(74)



them to any Scale of equal parts, & see how many parts they containe, and let A contain 24 parts, and B 36 of the same parts, then take 36 the length of the line B on some Scale of equal parts, and fit that on 24 the line A, then let the Scale rest, then take it over in the line B, viz. 36, and that distance lay down for the line C, which shall be 54, a third line in proportion required.

The Reason.

For as 36 is 24, one time half, so is 54 once, 36 and a half, and so consequently 54 is the third proportional required.

CHAP.



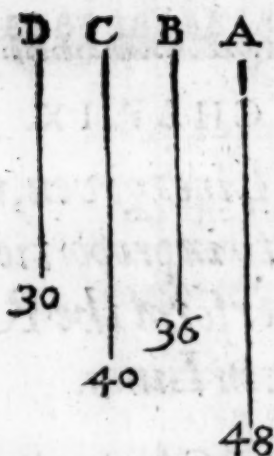
CHAP. IX.

*Unto 3 Lines given, to find
a fourth in proportion, that
is to perform the Rule of
Three in Lines.*

AS let A B C be the 3 lines, unto
the which it is required to finde
a fourth in proportion, that is, as the
first is to the second, so is the third
to the fourth.

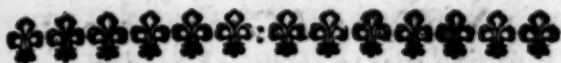
Take the three lines one after ano-
ther with your Compasses, and apply
them to any Scale of equal parts to
know their length, and suppose you
find them as the numbers which stand
by them.

Then take the second line B, and
apply it some Scale of equal parts, and
and fit that over in the length of the
first



first line 48, there let the Scale rest, then take it over in the third line C, viz. in 40, and that distance lay down for D, which is 30 parts of the same Scale, where the line A is 48, and is the fourth proportional required: for as A is to B, so is C to D, &c.

CHAP.



CHAP. X.

*To divide a line given
into two such parts,
bearing proportion one
to the other, as two
numbers given.*

A

AS let it be required to divide the given line A B into two such parts, bearing proportion one to the other, as 28 to 21, viz. that A C may be to C B, as 28 to 21

C

Adde your two given numbers together, viz. 28 and 21 make 49, then take with your Compaffes the given line, A B and fit it in 49, there let the Scale rest,

B

rest, then take it over in 28, which set from A to C, so is AC to BC, as 28 to 21, which was required to be done.



CHAP. XI.

To measure flat measure.

A Board being 16 inches broad, now it is required to find how much in length makes one foot.

Take on any Scale of equal parts 12, the number of inches in one foot, and fit that in the breadth of the board which is 16, there let the Scale rest, then take it over in 12 alwayes, and that apply to the same Scale of equal parts where the 12 was taken, and it sheweth 9, and so many inches in length make a foot of board required, for if a board have 16 inches in length and 9 in breadth, these two numbers multi-

multiplied together make 144 inches; the number of square inches contained in a foot of square board, or glass, &c.

Let a board be seven inches and three quarters broad, now it is required to find how much in length makes one foot.

Take (as before) 12 of some Scale of equal parts, and fit it on a seven three quarters, the breadth thereof, and then take it over in 12, as before, but to fit it in seven three quarters, would open the Scale too wide, therefore take four times seven three quarters, which is 31, and fit 12 in that, and take it over in four times 12, which is 48, and that distance applyed to the same Scale where the 12 was taken, sheweth 18 three fifths, and so many in length shall make one foot.

If a board be two inches broad, how much in length shall make a foot.

Multiply two the breadth of the Board,

Board, and 12 the inches in the foot by 10 makes 20, and 120, then take of some small Scale 120 (which may be done upon some Scale placed upon your Rule) and fit that on 20 on the Scale, and take it over in 12, and fit it in 2, 3, or 4 times 20, and take it over in so many times 12, and that apply to the same Scale, where the 120 was taken, and it sheweth 72 inches, and so many in length is a foot of Board, the Board being two inches broad.

Let a Board be three inches and three quarters broad, now you desire to know how much in length maketh a foot.

Bring three inches and a quarter into quarters, and it maketh 13 quarters, then multiply 12, the inches in a foot, into quarters, and it maketh 48: take then 48 parts of some small Scale and fit that in 13, then let the Scale rest, and take it over in 12, and apply that to the same Scale where the 48 was taken, sheweth 44 and one third part,

part, and so many inches in length is required to make a foot.

But having taken your 48 on some small Scale, and are to fit it on 13, now if it open your Scale too wide, you may fit it over in two or three times 13, and take it over in so many times 12, as fit 48 in four times 13, that is in 52, and take it over in four times 12, that is, in 48, and it sheweth, 44 and one third, as before, being applied to the same Scale where the 48 was taken.

Again, let a Board be 5 inches, and three eight parts of an inch broad, and it is required to find how many inches in length make a foot.

Bring five and three eights into eights, makes 43, and 12 into eights make 96, then take 96 and fit it in 43, or in twice 43, there let the Scale rest, and take it over in 12, and also apply it to the same Scale where 96 was taken, and it sheweth 26, and three quarters, and so much in length
 G makes

makes a foot of Board, the breadth being 5 inches, and three eight parts of an inch, which is the thing desired.



CHAP. XII.

To measure Board that is broader at one end then at the other.

Suppose a Board be broad at one end 20 inches, and at the other 16: now it is required to finde how much in length makes one foot throughout the whole Board.

Add the breadth at both ends together, and take halfe thereof for a mean breadth, so finde you 18, then is it all one as if your Board were 18 inches, and you would know how much in length makes a foot.

Take 12 and fit it in 18, and take it over

over in 12, and so much makes a foot.

Let a board be broad at one end ten inches and a quarter, and at the other seven and a halfe, now the desire is to know how much in length makes a foot.

Adde both the numbers together and take halfe, which maketh 8 inches and seven eight parts of an inch for the common breadth; then bring 8 inches and seven eights of an inch and 12 inches into eights, and it maketh 71 eights, and 96 eights. Take then 96 in some Scale, and fit that in 71, then let the Scale rest, then take it over in 12, and that apply to the same Scale where the 96 was taken, and it sheweth 16 and a quarter, and so many inches in length make one foot of Board.



CHAP. XIII.

To finde how many square feet any whole Board containeth, without finding how much in length makes a foot.

IMagine a Board be 15 foot long, and 16 inches broad, and it is required to finde how many square foot of Board it containeth.

Take the length of 15 on some Scale of equal parts, and fit that in 12 the inches in a foot (alwayes) there let the Scale rest, then take it over in 16 the breadth, and apply it to the same Scale where the length was taken, it sheweth 20, and so many square foot is found to be therein contained.

Let

Let a Board be 17 foot and a quarter long, and 16 inches and a halfe broad, and the desire is to know how many foot it containeth.

Take 17 and a quarter the length, and fit it in 12, and take it over in 16 and a half, and that apply to the same Scale where 17 and a quarter the length was taken, it sheweth 23 and two thirds, and so many foot it containeth.

Or you may bring 17 and a quarter into quarters, makes 69, and in like manner 12 into quarters, makes 48, and take it over in 16 and a halfe the breadth, so finde you 23 and two thirds as before.



CHAP. XIV.

*To measure Board that is
broader at the one end
then at the other, in the
same manner.*

Suppose a Board be broad at the one end 18 inches, and at the other end 14, and long 21 foot, I demand how many square foot it containeth.

Add the breadth at both ends together, makes 32 inches, whose halfe is 16 inches for a mean breadth, then proceed as before, take 21 and fit it in 12, and take it over in 16, or fit it in five times 12, and take it over in five times 16, so finde you 28 for the area required.

Again, let a Board be broad at the
one

one end 11 inches and a halfe, and at the other 7 and three quarters, and 15 foot and three quarters long, now the Area is required.

First, adde them both together, and take halfe, makes 9 five eight parts, for the mean breadth.

Then take 15 three quarters, the length on any Scale, and fit it in 12, and take it over in 9 five eights, and that applyed to the same Scale where the length was taken, and it sheweth how many foot it containeth.

Or bring 12, and 9 five eights, into eights, make 96 and 77, then fit fifteen three quarters the length, in 96. and take it over in 77, and that sheweth on the same Scale where the 15 three quarters was taken, twelve two thirds, the Area desired.

CHAP.



CHAP. XV.

To measure Timber.

Suppose a piece of Timber be 18 inches broad, and deep 16 inches, it is required to find how much in length doth make a foot.

Take twelve the inches in a foot on any Scale of equal parts, and fit that in the breadth eighteen, and take that over in twelve alwayes. Again, set that distance in sixteen the depth, and take it over in twelve still, and that apply to the same Scale where the twelve was taken shew six, and so many inches in length make a foot, the thing required.

Again, let a piece of Timber be broad sixteen inches, and deep thirteen and a halfe, and it is required to find how much in length make one foot.

As

As before, fit twelve in sixteen, and take it over in 12, and that apply to the same Scale where the twelve was taken, sheweth eight inches, and so many inches in length make one foot.

Again, let a piece of Timber be fifteen three quarters broad, and eleven three quarters deep: I demand how much shall make a foot?

Bring fifteen three quarters, and twelve into quarters, makes sixty three, & forty eight, then take twelve on some Scale of equal parts, and fit it in sixty three, and take it over in 48, and that distance fit in eleven one quarter, and take it over in 12: Or as before, bring eleven one quarter, and twelve both into quarters, makes forty eight and forty five, then fit it in forty five, and take it over in forty eight, and that applyed to the same Scale where the first twelve was taken, sheweth nine four fifths, and so many inches in length will make one foot.

If

If a piece of Timber be seven one quarrer broad, and five and a halfe deep, it is required to find bow much in length shall make a foot.

Bring seven one quarter, and five and a halfe into quarters, makes twenty nine, eight hundred twenty two, likewise twelve makes 48, then take twelve on any Scale of equal parts, & fit it on twenty nine, and take it over in forty eight, which distance fit again in twenty two, and take it over in forty eight, and that applyed to the same Scale where the twelve was taken, sheweth forty three one third part, and so maui inches in length make a foot, which was required to be done.

CHAP.



• CHAP. XVI.

*To measure Timber that is
broader at one end than
at the other:*

Suppose a piece being broader at the one end than at the other be given to be measured.

First, take some place neer the bigger end for a mean part, then take the breadth and depth thereabout, which suppose to be twenty and fifteen, then proceed as before, so find you 5 three quarters, and so many inches in length make a foot.

CHAP.



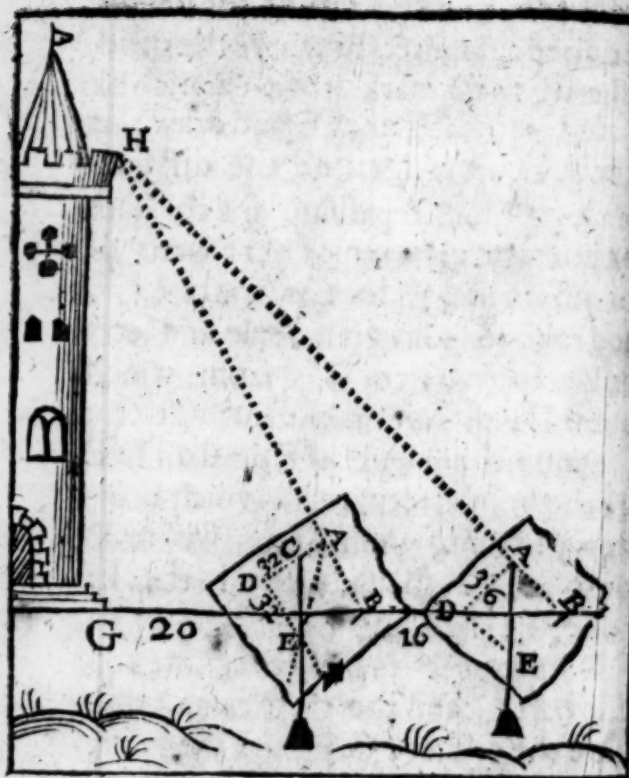
CHAP. XVII.

*How Perpendicular heights
may be found without ei-
ther Instrument or A-
ritbmetick.*

TAKE a trencher, or any simple boards end, of what fashion soever, such as you can get, and draw thereon a line towards one of the sides, as the line AB , and on the point A , raise a perpendicular, as AD , then in the line AB , knock in two pins, one at A , and the other at B , then on the point or pin at A , hang a thread with a plummet, then set up this board with the end A , towards the height required, till you bring the two pins, into one straight line, with your

your eye, and the top of the height required, and directly where the thread falleth, there mark it with a prick of your Compasse, as at E, and draw the line A E, now measure the distance between your standing, and the base of your altitude, which here wee will suppose to be 36 foot, as from F to G, and take 36 from your Scale, and set it down from A to D, from which point D, raise a Perpendicular, to cut the plumb-line A E in E, so shall D E be the height required, which being applyed unto your Scale, will reach unto 32, and so many foot is the altitude G H.

But suppose you cannot come unto the base G, and therefore cannot measure the distance G F, and yet it is required to find the altitude G A, therefore to perform this, first, take your standing at F, as before, and lift up your board, till you bring the two pins A and B into one straight line, between your eye, and the top at H, and directly where the thread falleth there



there make a mark, as at E, and draw
 the line A E, then measure out so ma-
 ny foot as you think good, in a straight
 line towards the base G, and there
 take your other standing, as here sup-
 pose

pose 16, this 16 take from your Scale, and place them from A to C, and in the point C hang your thread and plummet, and lifting up your Board, till you take your sight as before, make a mark directly where your thread crosseth the former plumbline A E, as at E, from which point E let fall a perpendicular to the line A D, as D E, so shall D E be 32 for the altitude of G H as before.

Here note, that the altitude thus found, is from the levell of the eye upwards, and therefore the height from the eye downwards is to be added thereto to make it complear.

CHAP.



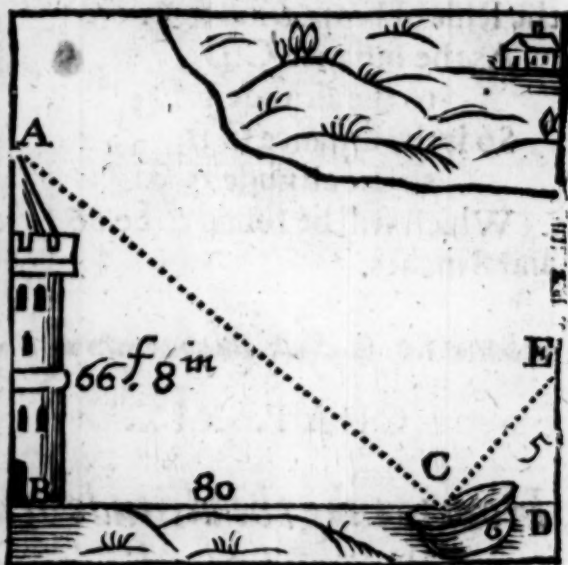
CHAP. XVIII.

*How to take the altitude or
height of a building by a
bowl of water.*

PLace on the ground a Bowle of water, which done, erect your body straight up, and go back in a right line from the building, till you espie in the center or middle of the water the very top of the altitude, which done, observe the place of your standing, and measure the height of your eye from the ground, together with the distance from your standing to the water, and the distance from the water to the base or foot of the altitude, which being all exactly taken, will help you to the altitude required by the Rule of proportion.

Ex.

Example, Let the altitude required be A B, the Bowle of water placed on the ground at C, then goe backward from C (your body erected as

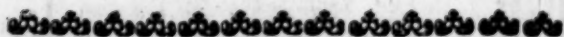


streight as may be) till your eye at E
 espie the top of the altitude A B in
 the water, which found, observe the
 place of your standing at D, and mea-
 sure the altitude from your eye to the
 H ground,

ground, which is five foot, then measure the distance from D to C, which is 6 foot, and likewise the distance from C to B which is 80 foot: these three distances being known, work by the Rule of proportion thus.

As the distance C D,
to the altitude E D;
So is the distance C B,
to the altitude A B:

Which will be found to be 66 foot
and 8 inches.

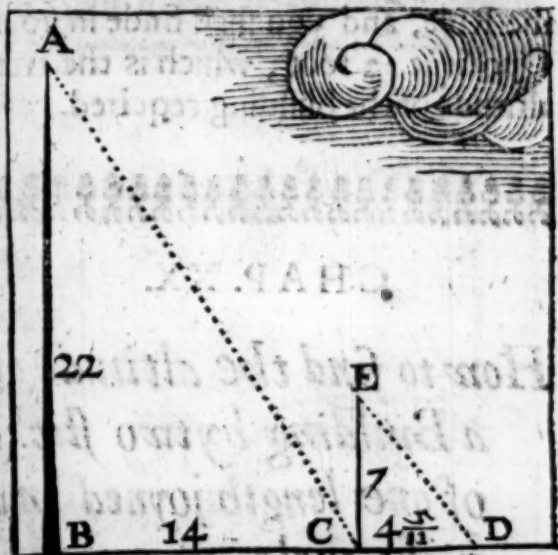


CHAP. XIX.

*How to take the altitude of a
Building by a line and
plummet the Sun shining.*

L Et the Building whose altitude
you desire to know be A B, cast-
ing his shadow in a right line to C, at
C

C let fall a line and plummet (whose length before you know in feet and inches) observing where the end of that shadow lighteth, which suppose



at D, then measure the length of the shadow of the string, and consequently the shadow of the Building, both which being exactly taken, work thus by the Rule of Proportion.

If C D the shadow of the line and plummet 4 foot $\frac{1}{2}$, give E C 7 foot

H 2

in

(100)

in altitude, what altitude doth 14 foot give, which is the shadow of the altitude required.

Multiply and divide according to the Rule, and you shall finde in your Quotient 22 foot, which is the true altitude of the building required.



CHAP. XX.

*How to find the altitude of
a Building by two sticks
of one length joyned in a
right angle.*

CAuse two sticks to be joyned in a right angle, as is in the figure M N and O P, having at O a hole made wherein to hang a thread and plummet.

The two sticks being thus prepared,

red, come to the building whose altitude you require (which building let be A B) then apply the end of your crosse staffe (noted with D) to your eye, and hold it up and down till the



thread and plummet hang just upon the perpendicular, then goe backward or forward till your eye at D looking over E, espy the top of the building at A, which found, marke well the place

of your standing, which is at F , and measure the distance from your eye to the ground, which is DF , and let that same distance off from F to C , then measure the distance from C to B , for that is the true height of the building AB .



CHAP. XXI.

*To finde a Distance by the
two sticks joyned square.*

THis experiment is grounded upon the fourth proposition of the 6 Booke of *Euclid*.

Let the distance which you desire to know be AB , set up a staffe at A of four foot long, (or more or lesse at your pleasure) as the staffe AC , at the end of the staffe C place a thread as CD .

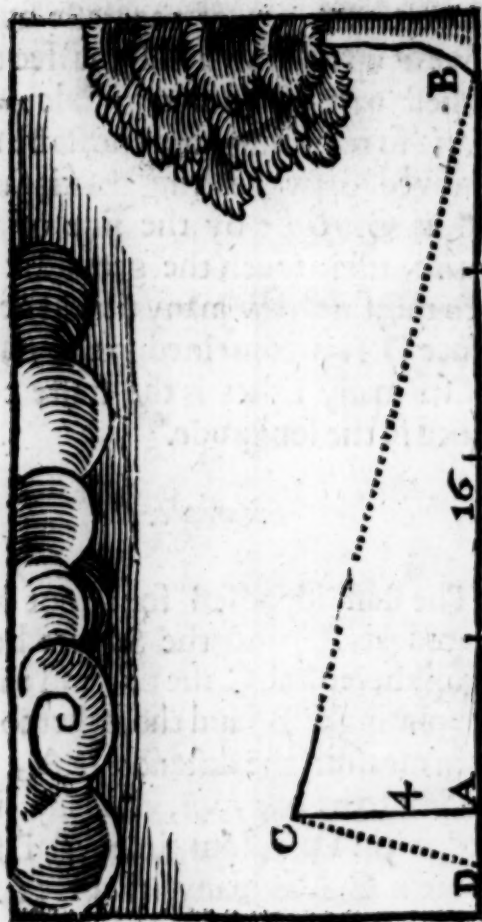
Then

Then hanging the angle of the square on the top of the staffe at C, move it up or down till you see the farthest part of your longitude: the square so remaining, and the staffe not removed, draw the string that is fastened at C, close by the side of the square, till it touch the ground at D, then measure how many times the distance D A is contained in the staffe, for so many times is the staffe contained in the longitude.

Example.

The staff supposed four foot high placed at A, and the Square being hung thereon at C, the one end thereof pointing at B, and the other to D, then measure the distance D A, and finde it to be one foot, then say, if C A contein D A, four times, A B shall contein C A as many, that is 16 foot as may appear by the figure.

CHAP.





CHAP. XXII.

*How to describe a Town or
City according to Cho-
rographicall proportion,
by the helpe of a plain
glasse.*

TO perform this conclusion,
you must resort to some high
place in the Town or Coun-
trei you would describe, from whence
you may behold all the Castles, Ports
Harbours, Bays, Gates, Forts, and
such other notable places as you in-
tend to describe: which place being
chosen, provide a plain glasse, which
in the midst of the Platforme hang
parallel to the Horizon, (in the doing
of

of which you must be very carefull)
 so that moving up and down the plat-
 forme, you may in the Center of the
 Glasse, see all those notable places
 The foundation being laid, let us
 now proceed to the worke; and first
 of all on your platforme, you must
 draw a Meridian line, which must
 passe just under the Glasse, so that if a
 perpendicular line were let fall from
 the Center of the Glasse to the plat-
 forme, it might cut the Meridian line
 at right Angles, and by having this
 line drawn, you may draw the line
 of East and West at right Angles to
 the Meridian; and in like manner, the
 two and thirty points of the Com-
 passe, with Circles and Parallels, as is
 usual in the projecting of Sea-charts;
 so that thereby you may know how
 all the chief places in the Town are
 situate, and how they bear from you:
 This done, move Circularly about
 the Glasse, observing alwayes when
 you espie any marke in the Center of
 your

your glasse to set up a staffe , writing thereupon the name of the place, whether it be Village, Port, Road, or such like, you shall in the end situate, as it were, the whole Countrey , in due proportion upon your platform, so that measuring the distance of every staffe set up from the Center of your platform, and the distance likewise of every staffe from other , you may by the Rule of Proportion, finde out the distance of every Town, Village, Fort, Haven, and the like, from your platforme; and also the distance between any two places there described. This Experiment is marvelous pleasant to practise, and most exactly serving for the description of a plain *Champion* Countrey , which when you have thus traced out upon the platform , you may , by the help of Scale and Compasses , project in paper or parchment with a Scale of Leagues, Miles, Furlongs, Paces, or other measures, as liketh you best.

F I N I S.



APPENDIX.

*Containing the use of the line
of Numbers, in the mea-
suring of Board, Glasse,
Pavement, Hangings,
Timber, Stone, &c.*

FOR the measuring of all kinds of Superficies and Solids, the Line of Numbers, (commonly inscribed upon the Carpenters Rule, and known to most Artificers by the name of *Gunters Line*) exceedeth all other both for facility and exactnesse, the
description

description and use whereof followeth.

CHAP. I.

The description of the Line of Numbers.

THe order of the divisions on this Line of numbers, and commonly on most other, is thus, it begins with 1, and so proceeds with 2, 3, 4, 5, 6, 7, 8, 9, and then 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; whose proper power or order of numeration is thus: The first 1 doth signifie one tenth of any whole number or integer; as one tenth of a Foot, Yard, Ell, Perch, or the like; or the tenth of a penny, shilling, pound, or the like, either in weight, or number, or measure; and so consequently, 2 is 2 tenths, 3, three tenths; and all the small intermediate divisions, are a 100 parts of an integer, or a tenth, of one of the former

(III)

former tenths; so that 1 in the middle, is one whole integer, and 2 onwards two integers, 10 at the end is 10 integers. Thus the line is in its most proper acception or natural division.

But if you are to deal with a greater number than 10, then 1 at the beginning must signifie 1 integer, and 1 in the middle 10 integers, and 10 at the 100 integers. But if you would have it to a figure more, then the first 1 is ten, the second a hundred, the last 10 a thousand. If you proceed further, then the first 1 is a 100, the middle 1 a 1000, and the 10 at the end is 10000, which is as great a number as you can well discover, on this or most ordinary lines of numbers: and so far with convenient care, you may resolve a question very exactly. Now any number being given under 10000, to finde the point representing it on the rule, do thus.

•
Nume-

Numeration on the Line of numbers.

Problem 1. *Any whole number being given, under four figures, to finde the point on the line of numbers that doth represent the same.*

First, Look for the first figure of your number, among the long divisions, with figures at them, and that leads you to the first figure of your number: then for the second figure count so many tenths from that long division onwards, as that second figure amounteth to; then for the third figure, count from the last tenth, so many centesmes as the third figure contains; and so for the fourth figure, count from the last centesme, so many milions, as that fourth figure hath unites, or is in value, and that shall be the point where the number propounded is on the line of numbers, take two or three examples.

First,

First, I would finde the point upon the line of numbers representing 12, now the first figure of this number is one, therefore I take the middle one for the first figure, then the next figure being 2. I count two tenths from that 1, and that shall be the point representing 12, where usually there is a brasse pin with a point in it.

Secondly, To finde the point representing 144. First, as before I take for 1, the first figure of the number 144, the middle Figure 1, then for the second Figure (*viz.* 4,) I count 4 tenths onwards for that: Lastly, for the other 4, I count 4 centesmes further, and that is the point for 144.

Thirdly, To finde the point representing 1728.

First, As before, for 1000, I take the middle 1, on the line.

Secondly, For 7, I reckon seven tenths onward, and that is 700.

Thirdly, For 2, reckon two centesmes from that 7th. tenth for 20.

I

And

And lastly, For 8 you must reasonably estimate that following centesme, to be divided into 10 parts (if it be not expres'd, which in lines of ordinary length cannot be done) and 8. of that supposed 10, is the precise point for 1728, the number propounded to be found, and the like of any number whatsoever.

But if you were to finde a fraction, or broken number, then you must consider, that properly, or absolutely the line doth expresse none but decimal fractions: as thus, $\frac{1}{10}$, or $\frac{1}{100}$, or $\frac{1}{1000}$, and more neerer the rule in common acception cannot expresse, as one inch, and one tenth, or one hundredth, or one thousandth part of an inch, foot, yard perch, or the like, in weight, number, or time, it being capable to be applyed to any thing in a decimal way; but if you would use other fractions as quarters, half quarters, sixteens, twelves, or the like, you may reasonably read them, or else reduce

duce them from decimals, to those fractions, of which more in the following Chapters, for more plainness sake, take two or three observations.

1. That you may call the 1. at the beginning either one thousand, one hundred, or one tenth, or one absolutely, that is one integer, or whole number, or ten integers, or a hundred, or a thousand integers, and the like may you call 1, in the middle, or 10, at the end. 2. That whatsoever value or denomination you put on 1, the same value or denomination, all the other figures must have successively, either increasing forward, or decreasing backwards, and their intermediate divisions accordingly, as for example:

If I call 1 at the beginning of the line, one tenth of any integer, then 2 following must be two tenths, 3 three tenths, &c. and 1 in the middle 1 integer, 2 two integers, and 10 at the end must be ten integers.

I 2

But

But if one at the beginning be one integer, then 1 in the middle must be 10 integers, and 10 at the end 100 integers, and all the intermediate figures 20, 30, 40, 50, 60, 70, 80, 90, integers, and every longest division between the figures 21, 22, 23, 24, 25, 26, &c. integers, and the shortest divisions tenths of those integers, and so in proportion infinitely: [1 ¹⁰ 1 . 10 [1 . 10 . 100 .] [10 . 100 . 1000 .] [100 . 1000 . 10000 .] in all which 4 examples, the first order of Figures, *viz.* $\frac{1}{10}$ 1 . 10 . 100 . represents the first 1, on the line of numbers: the second order of Figures, *viz.* 1 . 10 . 100 . 1000 . is represented by the middle 1 on the line of numbers: the last order or place of figure, *viz.* 10 . 100 . 1000 . is represented by the 10 . at the end of the line of numbers.

3 That I may be plain (yet further) if a number be propounded of 4 Figures, having two cyphers in the middle, as 1005 . it is expressed on
the

the line, between that prime to which it doth belong, and the next centesme or small division next to it; but if you were to take 5005 where there are not so many divisions, you must imagine them so to be, and reasonably estimate them accordingly. Thus much for numeration on the line, or naming any point found on the Rule, in its proper value and signification.



CHAP. II.

The use of the Line of Numbers in measuring any Superficial measure, as Board, Glasse and the like.

THE ordinary measure, and most in use, is a *Two-foot Rule* divided into 24 inches, and every Inch into 8 parts; that is Halfs, Quarters, and Half-quarters; but these parts not agreeing with the parts on the Line of Numbers, which are Decimals, or tenth parts, hath bred very much trouble; and there cannot be exactnesse

without taking of smal parts, as $\frac{1}{4}$ quarters of Inches, or else using of Reduction, and it is also as troublesome by Arithmetick as by the Line of Numbers. To avoid which, I would advise either to measure altogether by Foot-measure, (that is, a Foot divided into 100 parts, (or rather as is sufficient for ordinary use, 100) and then the divisions on the numbers will agree fitly to the parts on your Rule, without any trouble for Fractions; for so doing Fractions do become whole Numbers as it were, and are wrought accordingly: But if you use it not in measuring, yet you may have it set for to help you for the ready reducing of such Numbers as shall require it, though I shall apply it to Inches also, as it is commonly used, that it may appear usefull both wayes, accordingly as any man shall be affected.

The like reason holdeth for inches, Yards, Ells, and Perchss, or any other

other measure; for thereby the work is made more easie, as shall appear anon.

Therefore first by Foot-measure onely.

Problem 1. *The breadth of an Oblong Superficies given in foot-measure, to find how much in length makes a foot.*

Extend the Compasses from the breadth to 1, the same extent applied the same way from 1, will reach to the length required.

So the breadth being 8 tenths, or 0.80, the length to make a Foot Superficial will be found to be 1.25. Or shorter thus, as 8 tenths (or 80 of a 100) is to 1, so is 1 to 1, 25 of an hundred.

Prob.

Problem 2. *Having the length and breadth of any Superficies given in Foot-measure, to find the content of that Superficies in Foot-measure.*

Extend the Compasses 1 to the breadth, the same extent applyed the same way from the length, will reach to the Content.

Example, As 1 is to 8, the breadth: so is 15 the length to 12, the content required: for a piece of 8 tenths broad, and 15 foot long, containeth 12 foot.

Prob. 3. *Having the breadth and length of an Oblong Superficies given in Inches, to find the content in Inches.*

As 1 Inch to the breadth in Inches, so the length in Inches to the Content in square Superficial Inches.
So the breadth 30 Inches, and the length

length 183, the Content will be found to be 5400.

Or else, as 1 to 183, so is 30 to 5490 inches.

Problem 4. Having the breadth and length of an Oblong Superficies given in inches to find the content in feet.

As 144 the number of inches in one Foot, is to the breadth in Inches; so is the length in Inches unto the Content in Feet. So as 144 to 30, so is 183 to 38, 250, that is, to 38 foot and a quarter.

Problem 5. Having the breadth of an Oblong Superficies given in inches, and the length in feet and parts, to find the Content in feet, and such like parts, as the length was.

As 12 to the breadth in inches, so is the length in feet to the Content in feet.

As

As 12 unto 30, so is 15 to 37,50.

Problem 6. *Having the breadth in inches to find how much makes a foot in Inch-measure, (that is, how many Inches in length makes a foot.)*

As the breadth in inches to 144, so is 1 to the length in Inches. As 30 to 144, so is 1 to 48 inches 80 parts.

Problem 7. *Having the length and breadth of an Oblong Superficies to find the side of a square equal to it.*

Divide the space between the length and the breadth into two equal parts, and the middle point shall shew the side of the Square that shall be equal in *area*, or quantity, to that Oblong; so that a Square made of 11,32, is equal to an Oblong of 16 one way, and 8 the other way.

Prob.

Prob. 8. *Of a Circle.*

Having the Diameter of a Circle, to find the side of a square equal to that Circle.

As 10000 to 8862, so is the Diameter 15 to the side of the Square, 13,29, that is equal to the Circle.

Probl. 9. *Having the Circumference of a Circle to find the side of a square equal to the same Circle,*

As 10000 to 2821, so is the Circumference 47,13 to the side of the Square 13,29 equal to the Circle.

Probl. 10. *Having the Diameter to find the Circumference.*

As 1 is to the Diameter, so 3142 to the Circumference. Or as 7 to 22, so is the Diameter to the Circumference.

So

So the Diameter being 15, the Circumference will be about 47, 13, parts.

Probl. 11. *Having the Circumference to find the Diameter.*

As 3142 is to 1, so is the Circumference to the Diameter: Or, as 22 is to 7, so is the Circumference to the Diameter.

So the Circumference being 47, 13, the Diameter is 15.

Probl. 12. *Having the Diameter to find the Superficial content of a Circle.*

The extent from 1 to the 1 Diameter, being twice repeated (the same way) from 7854, will reach to the content required.



CHAP. III.

The use of the line of numbers in measuring of Solid measure such as Timber, Stone or such like Solids.

Probl. 1. By Foot-measure.

A piece of Timber being to be measured and not iust square, how to make it square.

DIVide the Space between the breadth, and the thickness, into two equal, and the Compasses shall stay at the side of the Square, equal to the oblong made of that breadth and thickness; which is the mean proportional between them. The breadth being 18, and thicknesse 6, the side of the Square will be found to be 10,38.

Probl.

Probl. 2. *Having the side of a square, equal to the base of any Solid given in foot-measure, to find how much makes a foot Solid in foot-measure.*

As the side of the square in foot-measure unto 1, so is 1 to a 4th. number, and that 4th. to the length. As 2.120 unto 1.000, so 1.000 unto 0,471, and that to 0,222, or thus, the extent from 2.120 to 1, will reach from 1, twice repeated to 0.222, and so much is the length to make a foot Solid at that Squarenesse.)

Probl. 3. *To find how much in length makes a foot at any breadth and depth without squaring.*

As 1 to the breadth in foot-measure, so is the depth to a fourth number, as that 4th. number to 1, so is 1 to the length in foot-measure.

Example, As 1 is to 2.50, so is
1.80,

1.80, to 4.50, then as 4.50 to 1, so is
1 unto 0.222, the length required. —

*Probl. 4. Having the side of a Square,
equal to the Base of a Solid given,
and the length thereof in foot-measure,
to find the content in feet.*

As 1 to the side of the Square in
foot-measure, so the length in feet to
a fourth number, and that fourth to
the content in foot-measure. The ex-
tent from 1 to 2, 12, twice repeated
from 15.25 shall reach unto 68.62.

*Probl. 5. Having the length breadth
and depth of a squared Solid given in
foot-measure, to find the content in
feet.*

As 1 to the breadth in foot-measure,
so is the depth to the Base in
feet; as 1 to that Base, so the length
in feet to the content in feet.

As

As 1 to 2, 50, so 1.80 to 4.50;
 then as one 1 to 4.50, so is 15.25,
 unto 68.625. The content required.

Prob. 6. *By inches (only) and feet and inches.*

Having the side of a Square, equal to the base of any Solid given in inches, to find how many inches in length will make one foot.

The side of the Square is found as in the first problem of this Chapter, or by the 7th. of board measure. Then as the side of the square, in inches to 41.57, so is one foot to a 4th. number, and that 4th. to the length in inches, and tenth part of an inch.

The extent from 25,45 unto 41,57 twice repeated from 1 will reach to 2,67, or more easie if it be squared, as the side of the square is to 12, so is 12 to a 4th. and that fourth to the length required. The extent from
 25,45

25, 45 to 12 being twice repeated from 12, will stay at 2,667, or more short 2.67.

PROBL. 7.

Having the breadth and depth of a squared Solid given in Inches, to finde the length of a Foot in Feet and Inches..

As 1 to the breadth inches, so the depth to a fourth number, which is the content of the base in Inches, then as this 4 number is to 1728, so is 1 to the length of a Foot Solid in Inch measure. As 1 to 21,6, so is 30 to 648, then as 648 to 1728, so is 1 to 2,667.

Or again thus.

As 12 to the breadth in Inches, so the depth in Inches to a fourth number, then as this fourth number is to 144 so is 1 to the length of a foot solid; as 12 to 21,6, so 30 to 54; then as 54 is to 144, so is 1 unto 2,667. the length required.

K

Prob.

Prob. 8. *Having the side of the square and the length thereof given in Inch-measure, to finde the content in feet.*

As 41.57, to the side of the square in Inches, so is the length to a fourth Number, and that fourth to the content in Foot-measure. As 41.57, to 25.45, so 183, twice repeated unto 68.62.

Prob. 9. *Having the side of a square equal to the Base of any Solid given in Inch-measure, and the length in Foot-measure to finde the content in feet.*

As 12 to the side of the Square in Inches, so the length in Feet to a fourth Number, and that fourth to the content in foot-measure. As 12 to 25.45, so 15.25 to 32.55. and 32.55 to 68.62. Or the extent from 12. to 25.45, twice repeated from 15.25, shall reach to 68.62, the content sought.

Probl.

Prob. 10. *Having the length, breadth and depth, of a Squared Solid given in Inches, to finde the content in inches.*

As 1 to the breadth in Inches, so the depth to the base, then as 1 to the base, so the length to the content in Inches. As 1 to 21.6, so 30 to 648. as 1 to 684, so that 183 to 118584.

Prob. 11. *Having the length, breadth and depth given in Inches, to finde the contents in Feet.*

As 1 to the breadth in Inches, so the depth in Inches to the base in Inches; Then as 1728 to the base, so is the length in Inches to the content in feet, as 1 to 21. 6, so 30 to 948, as 1728 to 648, so 183 to 68. 62,

Or you may say,

As 12 to 21. 6, so 30 to 54, as 144 to 54, so 18 to 68. 62.

(132)

Prob. 12. *Having the breadth and depth of a squared solid given in Inches, and the length in Feet, to finde the content.*

As 1 to the breadth in Inches, so the depth in Inches to a fourth number. Then as 144 to that fourth, so is the length in Feet to the content in Feet.

As 1 to 216, so is 30 to 648; then as 144 to 15.25, so is 648; unto 68.62. Or as 144 to 21.6, so 30 to 4.50: as 1 to 4.50, so 15.25 to 68.62. Or again,

As 12 to 21.6, so 30 to 54: then as 12 to 54, so 15.25 to 68.62, the content required.

Prob. 13. *Having the Diameter of a Cylinder given in Foot-measure, to finde the length of a foot solid in Foot-measure*

As the Diameter in Feet to 1.128, so 1 to a fourth, and that fourth to the

the length in Foot-measure.

The Extent from (the Diameter)
1. 25, to 1. 128, being twice repeated
from 1, will reach to 8. 148, the
length sought.

Prob. 14. *Having the circumference
given in Foot-measure, to finde the
length of a Foot solid in Foot mea-
sure.*

As the Circumference in Foot-
measure is 3. 545, so is 1 to a fourth,
and that fourth to the length sought.

As 3 f, 927 p. unto 3. 545, so is
that distance twice repeated from 1
to 0, 818 the length of a Foot solid.

Prob. 15. *Having the Diameter and
length of a Cylinder given in Foot-
measure, to finde the content in Foot-
measure*

As 1. 128 to the Diameter in
Foot-measure, so is the length in
Foot-measure to a fourth, and that
fourth

fourth to the content in Foot-measure.

The Extent from 1. 128 to 1. 25, being twice repeated from 8. 75, will reach to 10. 737, the content sought for.

Prob. 16. Having the Circumference and length of a Cylinder given in Foot-measure, to finde the content in Foot-measure.

As 3. 545 to the Circumference in Feet, so is the length in Feet to a fourth, and the fourth to the content in Foot-measure.

The Extent from 3. 545 to 3. 927, being twice repeated from 8. 75, will reach to 10. 74, the content in Foot-measure.

Prob. 17. How to measure Taper Timber that is bigger at one end then at the other.

The usual way for doing of this,
is

is to take the Circumference of the middle or mean bignesse, but a more exact way, is to finde the content of the base of both ends and add them together, and then to take the half for the mean, which multiplyed by the length, shall give you the true content.

Example.

A round pillar is to be measured whose Diameter at one end is 20 Inches, at the other end it is 32 Inches Diameter, and in length 16 Foot (or 192 Inches) the content of the little end is 314. 286, the Area or content of the greater end is 773, 142, which put together make 1087, 428, whose half 543, 714. multiplyed by 192 the length, gives 104393, 143. Cubical Inches which reduced into Feet, is 60 Foot, and 713 cubical Inches, for the Solid content of the Pillar. •

Probl. 18. *To measure a Cone, such as is a Spire of a Steeple, or the like by having the height, and Diameter of the Base.*

Example.

Example ; let a Cone be to be measured, whose base is 10 Foot, and the height thereof 12 foot, the content of the base will be found, by the 14 Problem of Superficial measure, to be 78, 54 ; Then this 78, 54 multiplied by 4, a third part of 12, the perpendicular or height of the Cone will give 314, 4, for the content of the Cone required, by the numbers work thus ; the extent from 1 to 4, will reach from 78, 54 to 314.4. But because there may be some trouble in getting the true perpendicular of a Cone, which is its height, take this rule ; First, take half the Diameter, and multiply it in it self, which here is 25, then measure the side of the Cone 13, and multiply that by it self, which here is 169, from which take the square of half the base, which is 25 your first number found, and the remain is 144 the Square root of which, is the height of the Cone, or length of the perpendicular.

Probl.

Probl. 19. *To measure a Globe or Spheare arithmetically.*

Cube the Diameter, then multiply that by 11, and divide by 21, gives you the true Solid content; let a Sphere be to be measured, whose axis or Diameter is 14, that multiplied by it self gives 196, and 196 again by 14 gives 2744, this multiplied by 11 gives 30184, and this last divided by 21 gives 1437. 67, for the content of the Sphere whose Diameter is 14. But more briefly by the Numbers thus, The extent from 1 to the Axis, being twice repeated from 3. 142, will reach to the Superficial content, that is, the Superficies round about. But if the same extent from 1 to the Axis be thrice repeated from 5238, it will reach to the Solid content; as 1 to 14, so 3. 142 to 617. being twice repeated, as 1 to 14, so 5278 to 1437. being thrice repeated. As for many sided figures if they

L have

length, you may have sufficient for them in the Chapter of Superficial measure, to finde the base, and then the base multiplyed by the length giveth the content. But as for figures of roundish form; they coming very seldome in use, I shall not in this place trouble you with them, for they may be reduced to Sphears or Cones, or Triangles, or Cubes, and then measured by those Problemes accordingly.



FINIS.



